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Short communication

The value of long term EEG monitoring in children: A comparison of ambulatory EEG and video telemetry

James J.P. Alix [a,*], Rosalind H. Kandler [a], Santosh R. Mordekar [b]

[a] Department of Clinical Neurophysiology, Royal Hallamshire Hospital, Sheffield Teaching Hospitals NHS Foundation Trust, Glossop Road, Sheffield S10 2JF, United Kingdom

[b] Department of Paediatric Neurology, Ryegate Children's Centre, Sheffield Children's Hospital NHS Foundation Trust, Sheffield S10 5DD, United Kingdom

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ABSTRACT

Purpose: Outpatient ambulatory EEG may be followed by inpatient video telemetry EEG when investigating children for possible seizures and for classification of epilepsy. We investigated the value of ambulatory EEG and subsequent video telemetry recording in our centre.

Method: The departmental EEG database was interrogated retrospectively for children undergoing ambulatory recording followed by inpatient video telemetry within an 18-month period.

Results: 30 patients fitted these criteria, 21 females, 9 males, age range 3–16 years. The mean interval between studies was 9 months. For ambulatory recordings 93% of studies were undertaken to ascertain if behaviours were epileptic. 66% of ambulatory recordings studies captured an event of interest and 63% were able to answer the question asked of the test. In video telemetry recording 80% of studies were aimed at ascertaining if events were epileptic or not, 20% were undertaken for classification of seizure type. 70% of recordings captured an ictus and were considered helpful in addressing the clinical question. Pooled together 90% of patients had a paroxysmal event captured and the clinical question answered by the recording techniques. In patients for whom ambulatory recording failed to capture an attack or answer the clinical question, 70% went on to have a successful video telemetry recording.

Conclusion: Both ambulatory EEG and inpatient video telemetry are effective tools for diagnosis of seizures. The majority of patients with failed ambulatory recordings go on to have successful video telemetry. Combining the two resources provides useful clinical information in nearly all instances.

1. Introduction

The diagnosis and classification of epilepsy in children remains challenging despite technological advances. While the centrepiece of clinical practice remains the clinical history, a brief 20–30 min outpatient EEG recording is often undertaken. However, an ictus is usually not captured and diagnostic doubt persists. Misdiagnosis can lead to inappropriate treatment, or no treatment, with considerable associated costs in health and economic terms.[1,2] In line with ILAE recommendations, clinicians are turning to prolonged EEG recording to provide answers in such cases.[3]

Ambulatory EEG (AB-E) recording is the most widely available prolonged recording technique and is often successful in capturing paroxysmal events.[4] The technique allows the children to go home and is well tolerated. The majority of such recordings are undertaken without simultaneous video recording which can hamper interpretation, particularly when recordings are marred by artefact, or if frontal lobe seizures are under consideration. Furthermore, to record seizures some children also require reduction of anti-epileptic medications under close supervision. In these circumstances inpatient video telemetry (VTEL) becomes the technique of choice; however, this requires facilities that are not widely available. Different centres have different practices with regard to when each test is ordered and in our experience the decision is often complex, taking into account patient/family circumstances, medication requirements and the need to assess ictal semiology. Often AB-E is undertaken first as it is more readily available, although this is not always the case. The value of AB-E and VTEL recording in children is not widely reported and the added value of video telemetry after AB-E is unknown. We investigated the success of AB-E and subsequent VTEL in capturing ictal events and answering the clinical question posed.

* Corresponding author. Tel.: +44 0114 271 3237.
E-mail address: j.alix@sheffield.ac.uk (James J.P. Alix).

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2. Methods

We interrogated the departmental EEG database for children having AB-E followed by VTEL with surface electrodes within an 18-month period. Referral criteria for such investigations in our centre include an attack frequency of at least one event every 48 h. 30 patients matched these criteria, representing approximately 10% of the total number of referrals for each of these investigations. All patients were under the care of a consultant paediatric neurologist. Electrode placement was according to the international 10/20 system. AB-E recordings were all undertaken without the aid of simultaneous video recording; clinical episodes were recorded on an event log detailing the time and nature of the event. The project was registered with the clinical governance department at Sheffield Children's Hospital NHS trust (project number SE1265).

3. Results

30 patients were identified, 9 males and 21 females (Fig. 1). The age range was 3–16 years with a mean of 10.8 years at the time of the AB-E. The mean time interval between the two investigations was 9 months. The length of recording for both tests is shown in Fig. 1. For AB-E studies, requests typically asked if events were epileptic in nature or not (93% of studies). In 7% the reason for referral was to ascertain if the patient was experiencing electrical status epilepticus in slow wave sleep, or non-convulsive status epilepticus. For VTEL recordings, 80% of studies were concerned with ascertaining if paroxysmal events were epileptic or not, the remaining 20% sought to classify seizures. The diagnoses reached by the studies are detailed in Fig. 1. Two AB-E recordings captured events of clinical interest but were unable to determine their nature: on one occasion as it was not clear if the diary entries matched abnormalities; on the other the EEG was obscured by artefact.

The most common reason for requesting either test was whether or not the patient was having epileptic seizures. For this to be accurately answered a typical attack must be captured. For AB-E recordings 66% of studies captured an event (Fig. 2). This compared to 70% for VTEL. When the two tests were combined 90% of patients had an ictus captured by one or other of the recording techniques. In one third of patients no event of interest was captured by the AB-E recording; of these cases 70% went on to have a VTEL successful in recording an attack. In only three cases (10%) did neither study record an ictal episode.

While capturing an attack is often the goal of AB-E or VTEL some studies have a different objective, for example, the investigation of a syndromic diagnosis such as electrical status epilepticus in slow wave sleep. In addition, ambulatory recordings are sometimes obscured by technical factors even though an event of clinical interest occurs during the recording. In such cases it is relevant to ask whether or not the study answered the question asked of it, i.e. was it helpful or not? In AB-E recordings 63% of studies were helpful in answering the clinical question posed; for VTEL 70% were of use (Fig. 2). 73% of patients for whom AB-E recording was unhelpful went on to have a useful VTEL. Only 10% of patients came away from both recordings with no answer to the questions being posed.

4. Discussion

This study examines the usefulness of AB-E and VTEL in capturing attacks under consideration as seizures and providing clinically relevant information in children. It also addresses the success of subsequent VTEL recording after what could be termed a failed AB-E study. This is an important issue as such resources are scarce and need to be used to the best effect possible. Despite the need for such information this study is, to the best of our knowledge, the first to address this particular question. Indeed, few reports have evaluated the use of AB-E and VTEL in children.

Using 48 h ambulatory recording Saravanan et al., reported that typical clinical episodes were captured in 57% of children, a similar figure that observed in our study which used variable recording durations.[5] Wirrell et al., also reported a similar figure for capture

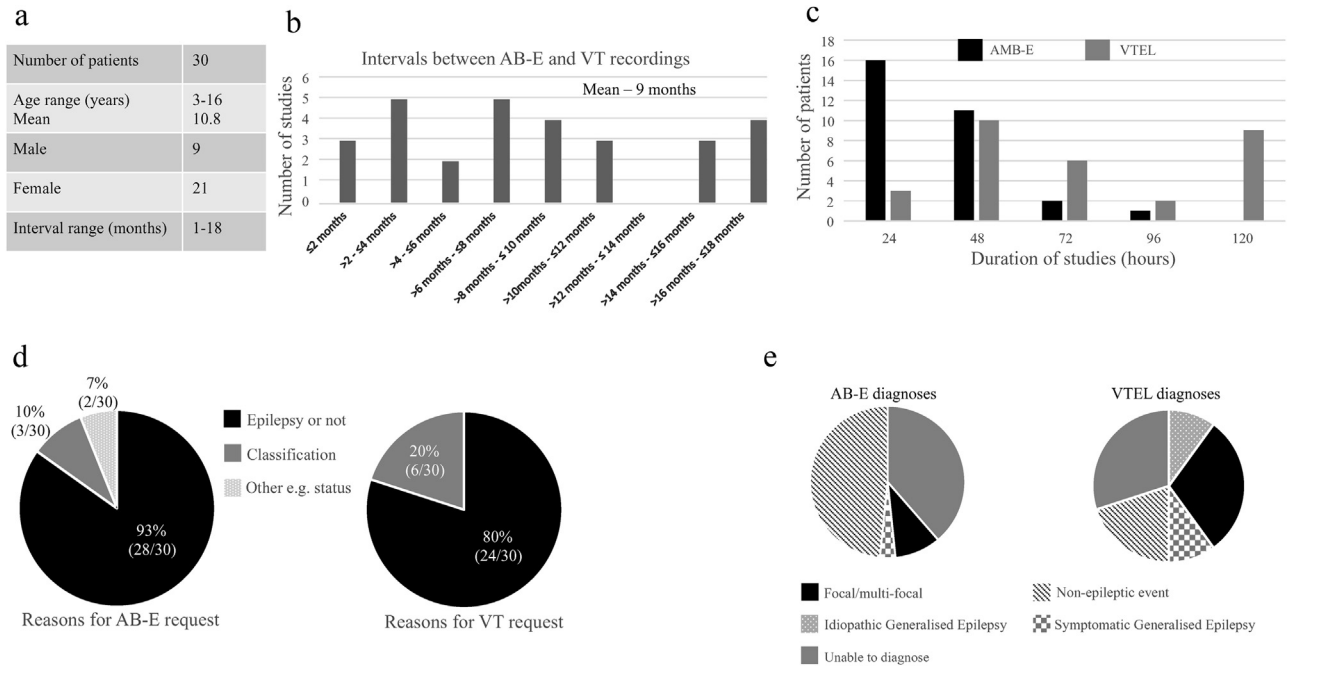

Fig. 1. Study characteristics, reasons for investigations and diagnoses reached. (a) Demographics of patients included in the study. (b) Histogram of intervals between AB-E and VTEL recordings. (c) Duration of recordings undertaken. (d) Reasons for AB-E requests (left), and VTEL request (right). (e) Diagnoses reached by the two types of recordings. In AB-E recording two studies captured attacks but were unable to ascertain their nature.

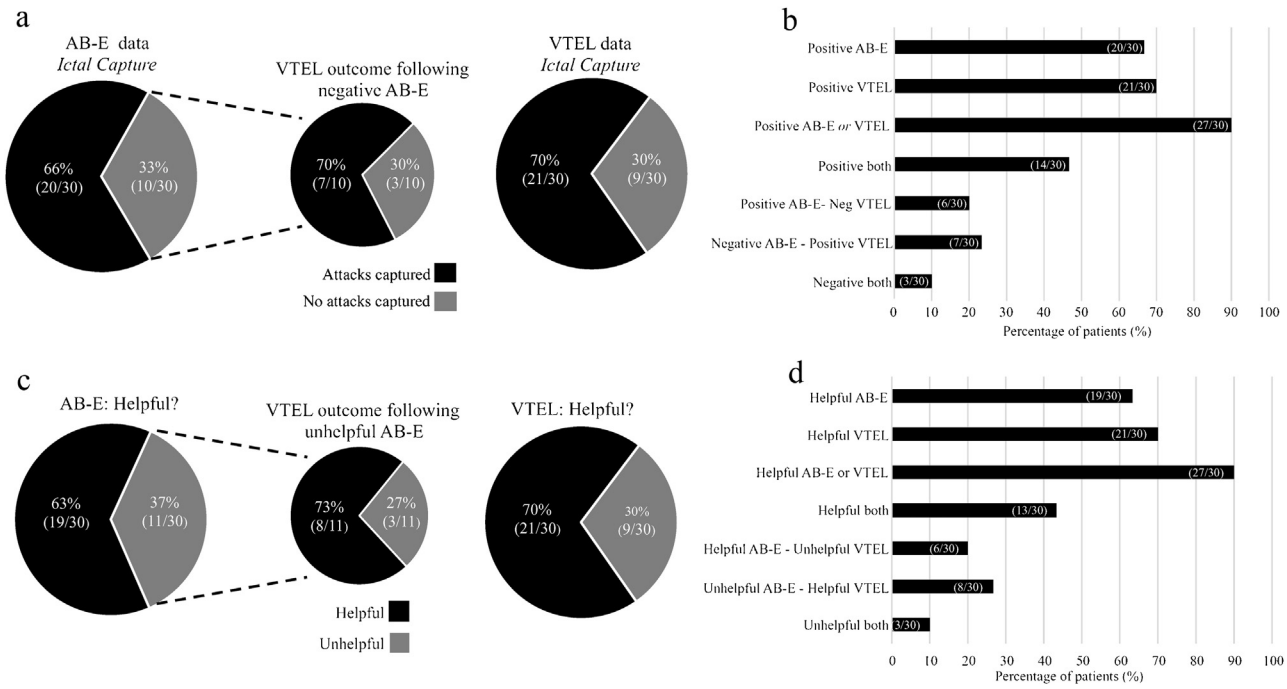

Fig. 2. Number of studies capturing ictal events and providing clinically helpful information. (a) Left: Percentage of AB-E studies capturing paroxysmal events. Centre: Outcome of VTEL studies after an AB-E recording that did not record an event of interest. Right: Percentage of VTEL studies capturing a typical event. (b) Percentage of patients with events capturing by AB-E or VTEL. Note 90% of patients had an event captured by either AB-E or VTEL. Only in 10% of patients did neither investigation capture a clinically relevant event. (c) Left: Percentage of AB-E studies capturing providing helpful information. 11 recordings were deemed unhelpful, on 10 occasions this was as no attacked was captured, in one recording artefact obscured the EEG. Centre: Outcome of VTEL studies after an AB-E recording that did not provide clinically useful information record an event of interest. Right: Percentage of helpful VTEL studies. (d) Percentage of patients with helpful investigations. In 90% of patients clinically useful information was garnered by one of the requested investigations. Only 10% of studies failed to provide the treating clinician with information relevant to that on the request form.

of ictal events (61%) and noted a contribution to the overall diagnosis in 73% of children[6]; the closeness of such observations to our own indicate that our data should be applicable to other patient populations in tertiary centres. Capture rates may be lower in less specialised settings.

VTEL is considered the gold standard for the diagnosis of paroxysmal events and prolonged inpatient investigations are typically used in difficult epilepsy cases; case series studies in combined adult and paediatric populations have shown that the majority of patients entering telemetry units are surgical candidates or suffering psychogenic non-epileptic attacks.[7] One might therefore expect attacks in such cohorts to be frequent relative to the average patient seen in an epilepsy service, and hence attacks to be captured routinely. In our exclusively paediatric cohort, ictal capture rate was similar to that obtained in previous reports.[8–10] The central tenant of our study was to examine the value of pursuing VTEL after AB-E recording, particularly failed AB-E studies, i.e. those that did not capture an attack or provide helpful information. While such numbers in our study are small it is clear that in the majority of instances (~70%) the extra effort and expense of inpatient recording was rewarded with a useful investigation. This is important as treating clinicians have to weigh up the potential gain of such an investigation against factors such as cost and disruption to the child's family.

On first inspection it is surprising that VTEL was undertaken if AB-E was successful, particularly as the reason for the test was often the same. One might have expected a repeated AB-E examination to be performed and in routine clinical practice this often is the case. However, these cases were not included in the present study which sought to look exclusively at AB-E followed by VTEL. The reasons for pursuing VTEL were multi-factorial but common features included a change in the nature of the attacks over time and home circumstances. Our own practice will continue to be adaptive to the need of the patient concerned. The improvements in AB-E in combination with video technology[11,12] will also influence future decisions.

Limitations of the study include the relatively small number of patients in our sample. In addition, while interval limit of 18 month allows for intra-patient comparison at similar ages several therapeutic changes may have been made between the studies. Thus, direct comparison of the AB-E and subsequent VTEL recording may not be a genuinely fair one. Furthermore, attack frequency at the time of study may impact on the likelihood of event capture. Several other factors may strongly influence this outcome, including, for example, drug reduction during VTEL. Thus, inpatient VTEL on a patient with fewer attacks than a patient undergoing AB-E might be more successful because of pronounced medication changes. That said, the population under study here is not an experimental one, rather it reflects clinical practice in a busy tertiary referral centre. The durations of recordings were also variable (VTEL typically longer than AB-E), however, this reflects case by case assessment and, in some instances, parental preference.

5. Conclusion

Both outpatient AB-E and inpatient VTEL are effective tools for diagnosis of seizures in children. The majority of patients with unsuccessful AB-E recordings go on to have successful VTEL. Combining the two resources provides useful and relevant clinical information in nearly all instances.

Conflict of interest statement

The authors report no conflicts of interest.

Contributions

J. Alix analysed the data and wrote the paper; R. Kandler and S. Morkekar conceived and designed the study and edited the paper.

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